PATENT SPECIFICATION

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COMPLETE SPECIFICATION

Improvements in or relating to Conveyors for Goods

We, FISHER & LUDLOW LIMITED, a British Company, of Bordesley Works, Clyde Street, Birmingham, 12, in the County of Warwick, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to conveyors of the kind comprising an elongated propeling element such as, for example, a flexible belt or band or a chain carrying a series of closely spaced transversely extending slats, and one or more goods or article supporting carriages adapted to be advanced by said propelling element to predetermined positions in which they are required temporarily to be brought to rest.

Such conveyors are used, for example, in assembly operations in which a succession of such carriages are advanced past a number of operators who are required to perform different assembly operations on the article or articles supported by each carriage, the carriages being consequently required to be brought temporarily to rest at such positions, and in so far as at different operating stations the period for which the carriages are required to be at rest varies, such requirement can only be met by stopping the carriages themselves without stopping the continued advancement of the propelling element which is itself usually an endless belt.

Hitherto it has been the usual practice in conveyors of the foregoing kind for the carriages to be provided with supporting wheels which engage with an upwardly directed surface of the belt or other propelling element, the lower surface of which has been supported by a skid plate, the arrangement being such that the carriages are advanced bodily by the belt without rotation of the wheels so long as they are not subjected to an external retarding force, while on applying such retarding force to a particular carriage so as to bring it to rest, the wheels then rotate under the continued forward movement of the belt or other propelling element.

With such an arrangement the whole of the weight of each carriage with its associated load is transmitted through the belt to the supporting skid plate, with the result that there will necessarily be a very substantial frictional force between the underside of the belt and the skid plate acting to retard the advancement of the belt, which force will be proportional to the weight of the carriage and its associated load, and in practice during the advancement of the carriage is likely to be approximately 50% of the weight of the carriage and its associated load.

This difficulty could not satisfactorily be overcome by replacing the skid plate by a number of rollers or other spaced supports, arranged at intervals along the length of the conveyor, as in such an arrangement the belt or other propelling element would then itself be displaced downwardly at positions intermediate each roller or other support under the applied load, and since the belt or other propelling element would then at such intermediate positions no longer be horizontal a very substantial retarding force indeed would then be applied by each load carriage to the belt or other propelling element.

Furthermore, with the hitherto known skid plate support for the belt or other propelling element when the carriage with its associated load is brought to rest by the application of an external retarding force, the retarding force acting on the belt or other propelling element will

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be increased still further by a value corresponding to this retarding force.

Such an arrangement is open, therefore, to the following two series objections.

(a) The belt or other propelling element is subjected both when the carriage is advancing as well as when it is stationary to a very substantial retarding force, which force may be of the order of 50% to 60% of the weight of the carriage and its associated load.

(b) By reason of the weight being transmitted from each loaded carriage through the belt or other propelling element to its supporting skid plate, the under side of the belt or other propelling element is subjected to very considerable wear arising from the friction between the under side of the belt or other propelling element and the skid plate.

In consequence, where a substantial number of carriages are provided, particularly where these are required to carry heavy loads, belt, or other propelling elements, more especially in the case of the customary belts, belts of enormous strength are necessary if they are to transmit the required load without breaking, with consequent very substantial addition to both the initial as well as the replacement cost of the conveyor; while the power required to drive the belt or other propelling element is itself substantial, calling for the provision of an electric motor or other power unit and its associated equipment of relatively large size. Further the relatively frequent replacement of the belt or other propelling element arising from the wear aforesaid increases still further the replacement costs of such a form of conveyor installation.

The present invention has for its object the provision of an improved arrangement in which the foregoing serious disadvantages are at any rate largely eliminated and in which the propelling force transmitted to each load carriage increases with increase of resistance to advancement of the carriage concerned.

According to the present invention each carriage is supported for its advancing movement from a track which is separate from the propelling element itself, each carriage being provided with a propelling element engaging member constituting a driving member, said driving member being mounted on the carriage for pivotal movement in relation thereto about an axis transverse to the direction of advancement of the carriage and being adapted releasably and frictionally to engage with a surface of the propelling element at a position which for the designed direction of advancement of the carriage is situated rearwardly in relation to the said axis of pivoting of the driving member relative to the carriage, such that an increase in resistance to the advancement of the carriage tending to retard this relative to the propelling element causes the driving member to turn about its pivot relative to the carriage in a direction to increase the frictional force between it and the propelling element so as thereby to transmit an increased propelling force to the carriage.

With such an arrangement it is possible for any carriage to be brought temporarily to rest as required by the operator without in any way stopping the propelling element itself, namely by pivoting the driving member relative to the carriage in a direction to disengage it from the propelling element.

By arranging the driving member in relation to the carriage in the manner above referred to in accordance with this invention an increased propelling force is applied to the carriage despite an increase in the resistance to advancement of the carriage arising for example, as a result of increased loading of the carriage, or as a result of the carriage being advanced upon an upwardly sloping track, or upon a track the upward slope of which is increasing.

The driving member preferably has a propelling element engaging surface of convex configuration with the axis of curvature of each part of the convex surface extending in each case parallel to, but in the rear of the axis of pivoting of said member in relation to the designed direction of advancement of the carriage by said driving member.

Preferably in order to obtain optimum frictional engagement between the driving member and the propelling element despite variations in the distance between the operative face of the propelling element and the axis of pivoting of the driving member arising, for example, from variation in the thickness of the propelling element where this is a belt, the shape of the operative surface of the driving member is such that irrespective of the distance between the operative face of the propelling element and the axis of pivoting of the driving member considering these two parts in operative position. the line passing through the line of contact between the driving member and the propelling element on the one hand and the axis of pivoting of the driving member on the other hand is disposed substantially at the angle of friction between the interengaging propelling element and

driving member surfaces having regard to the nature of the surfaces of the element and the member with which it engages.

Preferably, the amount of the mass of the loaded carriage supported by the track is a major proportion of the entire mass and the arrangement may be such that a saving of 90% may be effected in the propulsive force required to advance each carriage, such saving arising, of course, from the fact that the carriage is now supported by a separate track with only a proportion of the weight of the loaded carriage being applied to the belt or other propelling element through the driving member aforesaid.

The invention is further applicable to conveyors of the foregoing kind in those particular circumstances in which variation in the velocity of the carriage in relation to that of the propelling element is liable to occur and it is desired to control such variation.

One such particular circumstance is the case where the carriages are being advanced in either a substantially horizontal direction or in a direction which is inclined upwardly to the horizontal and in both cases at a pretermined velocity and it is required to advance the carriage in a direction which is inclined downwardly to the horizontal so that there is a danger of the carriage accelerating gravitationally, which gravitational acceleration may be undesirable.

A further example of such a circumstance to which the present invention is applicable is the case in an assembly operation for which a succession of carriages are required to pass different assembly positions at different speeds being driven past such positions by separate propelling elements advancing at different corresponding velocities, the carriages passing successively from a faster to a slower moving position and it is desired immediately to retard the velocity of the carriages as they pass from the faster to the slower moving propelling element.

In so applying the invention, according to a further feature thereof we provide each carriage with a pair of propelling element engaging members, one of which constitutes the driving member aforesaid and the other of which constitutes a retarding member, both of these members being adapted frictionally to engage with the propelling element, the driving member being adapted operably to engage with the propelling element when the carriage is tending to move at a slower rate than that of the said element thereby to effect advancement of the carriage at a speed corresponding to that of the propelling element and the retarding member being adapted to operably engage with the propelling element when the carriage is tending to move faster than the propelling element so as thereby to inhibit movement of the carriage at a velocity greater than that of the propelling element.

Displacement of one or the other of said two element engaging members may be effected by one or more controlling member or members being operatively connected to the or one of the propelling element engaging members respectively as well as with the carriage and adapted for light frictional engagement with a surface of the propelling element in all operative positions of the associated engaging member or members, the arrangement being such that relative movement between the propelling element and carriage is transmitted by light frictional engagement through the controlling member or members to the associated engaging member or members for the purpose of bringing one of the other of these members into operable frictional engagement with the propelling element for the purpose above described.

By the expression "light frictional engagement" is meant herein frictional engagement of such a nature as to effect actuation of the controlling member without being sufficient to transmit a significant propelling force therethrough from the propelling element to the carriage.

In the above arrangement a single controlling member would preferably be provided connected to the two propelling element engaging members and these two members together with the controlling member would all be mounted for pivotal movement in unison on the carriage about an axis transverse to the direction of advancement of the carriage, the propelling element engaging part of the controlling member being conveniently disposed symmetrically in relation to the said two engaging members.

The invention is illustrated in the accompanying drawings wherein:—

Figure 1 is an end elevation partly in section showing a simple embodiment of the invention as applied to an ordinary endless belt conveyor.

Figure 2 is a sectional view on the line 2—2 of Figure 1.

Figure 3 is a part sectional side view showing the application of the invention to an overhead endless belt conveyor.

Figure 4 is a sectional view on the line 4—4 of Figure 3.

Figure 5 is a sectional view to an en-

larged scale of a part of the construction depicted in Figures 3 and 4.

Figure 6 is a side elevation of a part of a further form of conveyor embodying the present invention, the part being depicted in a position for advancing one of the supporting carriages.

Figure 7 is a sectional view on the line 7—7 of Figure 6.

Figure 8 is a side elevation of part of the construction depicted in Figure 6, showing the parts in a position for retarding one of the supporting carriages.

Figure 9 is a sectional view to enlarged scale of part of the construction depicted in Figures 6 and 8.

Referring firstly to Figures 1 and 2, the endless belt conveyor there illustrated comprises a base 10, the upper surface of which as shown is horizontal although it may, if desired, be disposed at a small inclination to the horizontal, the base having mounted on its upper surface a skid plate 11, which extends continuously, or substantially continuously, longitudinally of the conveyor so as to provide a continuous or substantially continuous support for the underside of the upper or carriage advancing run 12 of the endless belt, which endless belt may be formed of rubber or canvas in the usual way, but has a width and thickness appreciably less than that requisite with existing hitherto known constructions in which the whole of the weight of a similar load is supported through the upper run of the belt.

With the present arrangement each of the goods or article supporting carriages 13, is supported primarily from the base 10 providing the latter with a pair of transversely spaced tracks 14 of channel configuration, arranged one on each side of the skid plate 11, the tracks receiving and supporting the carriage wheels 15.

As illustrated the carriage is depicted in the form of a shallow tray so as to provide an article receiving space 16, the base of which constitutes a load supporting platform 17, but the exact configuration of the carriage is, of course, immaterial. The endless belt is driven by any conventional driving means not shown so that the upper run is advanced in the right hand direction in Figure 2, and the forward end of the carriage 13 is provided with a horizontal transversely extending trunnion 18, on which is mounted for pivotal movement about a horizontal tranverse axis a driving member 19 which, as shown, is constructed in the form of a shoe of arcuate configuration so as to present on its underside a propelling element engaging face 20, which is convex about an axis parallel but to the rear of the axis of pivoting of said driving member 19 and the latter is so shaped as having regard to the dimensions of the carriage as to engage with the upper surface of the belt at a position 21 which for the designed direction of advancement of the carriage indicated by the arrow in Figure 2, is spaced rearwardly in relation to the axis of pivoting of the driving member 19.

The operative surface of the driving member 19 is formed by a lining member 22 separate from the member 19 itself, such lining member having a high coefficient of friction and formed for example, of a brake lining material or a plastic or transversely ribbed rubber strip.

The actual shape of the convex operative face 20 of the driving member is preferably such that for all vertical displacements of the upper surface of the belt in relation to the axis of pivoting of the driving propelling member, the line passing through the line of contact between the driving member and the belt and the axis of pivoting of the driving member is at an angle of approximately 35° to 40° in relation to a vertical transverse plane passing through said axis of pivoting; with the particular above specified material for the belt and driving member surfaces the line passing through the line of contact and axis of pivoting aforesaid is disposed substantially at the angle of friction between the belt and driving member surfaces where they engage with one another. Such an arrangement with the materials indicated for the belt and driving member surface 20 ensures optimum frictional engagement between the driving member surface and the belt despite variations in belt thickness, i.e. in the height of the upper surface of the belt in relation to the track 14 carrying the carriage supporting wheels.

With the arrangement above described it will be appreciated that if the upper run 12 of the belt is advancing in the right hand direction indicated in Figure 2 and the driving member is brought into engagement with the upper surface of the belt in the manner indicated in that figure the carriage 13 will be advanced in that same direction by reason of the frictional engagement between the operative surface of the members 19 and the belt.

Further, since the driving member 19 is mounted for pivotal movement in relation to the carriage 13 about a horizontal transverse axis and engages the belt at a position 21 which is situated rearwardly in relation to such axis of pivoting, and since furthermore the axis of curvature of the surface of the driving member is

situated rearwardly of the axis of pivoting if the carriage is subjected to a force tending to retard it in relation to the advancing belt the position 21 where it engages with the belt is necessarily caused to move forwardly and thus downwardly in relation to the carriage so as to apply an increasing downward force on the upper run of the belt, tending to raise the forward part of the carriage in so doing in relation to the track 14, and thereby apply an increased downward pressure from the driving member 19 to the belt.

In other words if the carriage 13 is subjected to a retarding force with the driving member 19 in frictional engagement with the belt the driving member at the point of contact 21 performs a kind of toggle movement in relation to its axis of pivoting to the carriage, tending to raise the forward end of the carriage in so doing.

In any event the driving member tends to move into a position to compensate for any tendency to slip between the driving member and the belt, arising from increase in external resistance to the advancing of the carriage by the belt.

As an example of the effect of driving each carriage in accordance with the present invention as above described, in a particular test in which a single carriage was advanced firstly by supporting it through its supporting wheels on an advancing belt as in the hitherto known arrangement, a propelling force of approximately 23 to 24 lbs. had to be applied to the belt to advance the carriage, while when the same carriage was placed on a narrower but otherwise identical belt so as to be advanced in accordance with the present invention a propelling force of only 3 lbs. was required to be applied to the belt before the carriage commenced to advance. Thus it will be appreciated that with the present invention the saving in belt loading and thus in belt strength, size, cost, is most substantial, while there is further a substantial saving in belt wear as well as in the power required for driving the belts.

Means may be provided for bringing any particular carriage to rest by manually, or if desired mechanically or electrically displacing the driving member 19 concerned out of engagement with the belt and in such an arrangement the trunnion 18 may itself be mounted for pivotal movement in relation to the carriage and have the driving member 19 secured thereto, one or each end of the trunnion 18 carrying an arm 23 adapted to be displaced manually or if desired by a mechanically or electrically operated and selected member not shown to thereby bring the carriage to rest at a predetermined position and where, for example, a succession of carriages are being advanced past the operator at an assembly position in an assembly conveyor installation, such arm may project forwardly beyond the front of its associated carriage so that when the latter is advanced up to an already stationary carriage at such assembly position it engages with the rear end of such already stationary carriage so as to displace its associated driving member rearwardly out of engagement with the belt, thereby bringing the advancing carriage to rest.

With the present invention when a carriage is brought to rest in any of the ways above described it will be appreciated that the carriage is completely disengaged from the belt so that under these conditions no retarding force whatsoever is being applied to the belt by such carriage instead of an increasing retarding force being applied to the belt as would be the case with a stationary carriage in the hitherto known arrangement.

In a modification of the arrangement depicted in Figures 1 and 2 the driving member may be constructed in the form of a leaf or the equivalent spring and the carriage may be spring supported on the adjacent pair of supporting wheels, the arrangement being such that increase in load on the carriage is accompanied by a downward displacement of the carriage in relation to such pair of supporting wheels against the loading provided by the spring support, such downward displacement causing the driving member spring to be stressed to a greater extent so as to apply a greater spring pressure to the upper surface of the belt corresponding to such increase in loading of the carriage. Such driving member spring would be of relatively light and flexible configuration so as only to apply a relatively small downward load to the belt when the carriage was unloaded.

Referring now to the further construction depicted in Figures 3 to 5 the invention is here depicted as applied to an arrangement in which the propelling element is again in the form of an endless belt 12, but the track indicated again at 14 is spaced below the propelling element the track 14 and the carriages 13 supported therefrom being of the general form described in our prior Specifications Nos. 639,244 and 639,249 in which each carriage comprises a single pair of links 24 connected together at each end by a connecting body 25, each connecting body being provided as described in such specifications with two pairs of track engaging

wheels or rollers 26, 7 rotatable about mutually perpendicular axes for engaging with the track as described in the foregoing two specifications, particularly No. 639,244.

In the particular construction illustrated the goods or articles to be advanced by each carriage are suspended from beneath the carriage by connecting together the two links 24 by a pair of longitudinally spaced pins 6, from which are supported a pair of transversely spaced suspension plates 27 of generally inverted triangular configuration, the two plates at their lower ends being connected by a load supporting pin 28 for receiving detachably a load suspension hook 29.

As described more particularly in the said Specification No. 639,249 the track 14 is supported at intervals along its length by connector plates 30, which connector plates carry above the track a sheet metal guideway 31 of inverted channel configuration the sides of which are formed with oppositely directed horizontal edge flanges 32 which support slidably longitudinal edges of the belt 12 so that this is supported at a fixed height above the track 14 for movement in a direction parallel to the length of the adjacent part of the track.

The two suspension plates 27 are connected at a position medially of the length of the carriage 13 by a horizontal transversely extending pivot pin 33 upon which is mounted pivotally a pair of propelling elements of belt engaging members.

For the direction of advancement of the belt 12 indicated; i.e. in the right hand direction in Figure 3, one of these members; namely the member 34, constitutes a driving member and the other of these members; namely the member 35, constitutes a retarding member.

Each of these two members is of the same general configuration as that of the driving member 19 of the preceding construction; that is to say each member is constructed in the form of a shoe having a convex face carrying a friction lining 20, adapted to engage with the adjacent i.e. undersurface, of the belt 12.

The two members 34, 35, are each provided with an integral supporting arm 36, the two arms being connected rigidly together at the ends thereof which are remote from the said members 34, 35 through the medium of a part-circular bearing member 37 which engages pivotally with the said pivot pin 33, the two arms diverging relatively from their point of connection and being bent in opposite directions at their outer ends in directions which are substantially longitudinal of the belt to form the said driving and retarding members 34, 35 respectively. The arrangement is such that when the belt 12 is advanced in relation to the carriage in one or the other direction, one or the other of these two members 34, 35 is displaced frictionally by its engagement with the belt in a direction for increasing the frictional pressure exerted by such member 34, 35 as the case may be on the belt so as to increase the propelling force applied to the carriage therethrough for advancing the carriage in such direction of advancement of the belt in relation to the carriage, in the manner already described; i.e. when the belt is advanced in the direction indicated in Figure 3 and relative to the carriage with the member 34 in engagement with the belt, this then serves as a driving member for advancing the carriage.

The semi-circular bearing member 37 carries symmetrically between the two arms 36 a controlling member 38 comprising a tubular part 39, one end of which is secured to the semi-circular bearing member 37 and having slidable therein a stem 40 the outer end of which constitutes a controlling finger 41 adapted at its outer end for substantially line engagement with the under side of the belt, about a line extending perpendicular to the direction of advancement of the belt, a very light spring 42 being provided acting between the stem 40 and an abutment 43 within the tubular portion 39 so as to maintain the finger of the controlling member in light frictional engagement with the belt irrespective of variation in the angular position of said member.

The arrangement is such that normally only one of the two belt engaging members is in engagement with the under side of the belt with the controlling member 38 in such position inclined either forwardly or backwardly in relation to the direction of advancement of the belt instead of being perpendicular thereto and if, for example, the carriage is being propelled at a constant rate in the direction indicated in Figure 3 through the medium of the driving member 34 in the general manner already described and the carriage commences to accelerate in relation to the belt, for example, gravitationally as a result of the carriage descending an incline in the conveyor installation, the driving member 34 will, under the acceleration of the carriage relative to the belt, tend to move out of engagement with the belt thereby pivoting itself together with the controlling member and the retarding member 35 in an anticlockwise direction in Figure 3 and relative to the carriage until the member 34 is out of oper-

ative engagement with the belt, whereupon only the controlling member itself is momentarily in engagement with the belt; with the parts being now substantially in the position depicted in Figure 3.

In consequence of this continued engagement of the belt with the controlling member by reason of the continued advancement of the carriage relative to the belt, the controlling member 38 is caused to continue this pivotal movement and the retarding member 35 is now brought into engagement with the belt.

The retarding member 35 is pivoted to the carriage at a position which is to the rear (in the direction of relative advancement of the carriage) of the position at which it is adapted to engage with the belt and has the centre of curvature of its belt engaging surface disposed forwardly of its axis of pivoting under these conditions. Accordingly the retarding member as soon as it engages with the belt acts in a direction for inhibiting further forward movement of the carriage in relation to the belt so that the carriage velocity is immediately reduced to that of the belt and undesirable gravitational acceleration of the carriage avoided.

When the resistance to the forward movement of the carriage exceeds the gravitational forward force thereon so that the carriage tends to move in the opposite direction in relation to the belt, the operating member and the two belt engaging members 34, 35 are pivoted similarly in the clockwise direction to disengage the retarding member 35 and re-engage the driving member 34 so that the carriage is still advanced at belt speed.

Instead of pivoting the two belt engaging members, 34, 35 together about a common axis, they may be pivoted about separate axes disposed, for example, at opposite ends of the carriage and connected together by a link which may be in the form of a light bowed spring link carrying the operating member, such an arrangement ensuring that the controlling member 38 engages the belt with a substantially constant spring pressure irrespective of substantial variation in its angular position. In such an arrangement the controlling member 38 may again be made in two parts slidable one within the other, one part being pivoted to the carriage substantially centrally of the length thereof and the other part being slidable through a guide provided on the bowed spring link.

Alternatively with the construction depicted in Figures 3 to 5 the retarding member 35 and the controlling member 38 may be omitted, that is to say only the driving member 34 will be provided with the device functioning in the same way as the construction shown in Figures 1 and 2.

In Figures 6 to 9 is depicted a further arrangement embodying the present invention, in which provision is made for automatically disengaging the driving member from the propelling element so as to bring the carriage to rest at one or more predetermined positions along the conveyor, provision being further made for initiating further advancement of the carriage automatically after at each such position the unloading and reloading operation has been performed.

In the particular arrangement illustrated in Figures 6 to 9 each carriage 13 and its associated supporting track 14 is constructed in a manner generally similar to the construction shown in Figures 3 to 5, but instead of the propelling element constituting an endless belt the propelling element, which is again indicated generally at 12, is constructed as an endless chain constructed as described in our prior Specification No. 639,244 and supported from a track 12a.

Each pair of links constituting the propelling element 12 is provided with a depending horizontally longitudinally extending driving plate 12b adapted for engagement with the propelling element engaging members 34, 35, in a manner similar to the endless belt of the preceding construction.

With the present construction these two propelling element engaging members 34, 35, again constitute respectively driving and retarding members and are mounted similarly for a common pivotal movement upon a transversely extending pivot pin 33 similarly supported between a pair of suspension plates 27 mounted on each carriage 13 as in the case of the preceding construction.

With the present construction the bearing member 37 engages with the pivot pin 33 is of tubular form and is provided centrally of its length with a spring anchorage plate 44, this plate on the reaward side (in the direction of advancement) of the pivot pin 33 being connected to one end of a stop spring 45 and on its other side being connected to one end of a start spring 46.

These two springs which are each constructed as tension springs depend substantially vertically from the spring anchorage plate 44 and are each connected at their lower ends to a corresponding pin 47, 48 respectively, the two pins extending between and being connected to a pair of load supporting plates 49, which plates are mounted for a limited vertical

movement in relation to the suspension plates 27 by providing two plates 49 with a pin 50, the ends of which work within vertically extending slots 51 provided in the lower end of each of the suspension plates 27, as is clearly shown in Figure 7.

The load supporting pin 28 on which the load suspension hook 29 is detachably mounted, is carried between the lower end of these two load supporting plates 49.

The start spring 46 is of a length somewhat greater than that of the stop spring 45, although the two springs are otherwise of similar configuration, the arrangement being such that when the line joining the points of attachment of the two springs to the plate 44 is horizontal the pin 48 associated with the start spring 46 is at a lower level than that of the pin 47 associated with the stop spring 45, and the arrangement is such that when a load is applied to the load supporting pin 28 tending to displace the load supporting plates 49 downwardly into the position depicted in Figure 6, the plates 49 will turn if subjected only to the constraint of the springs 45, 46 into a position in which the pin 28 is substantially vertically beneath the pin 50.

The relative length and strength of the two springs 45, 46 is such that in this position a very small resultant torque is applied to the anchorage plate 44, tending to pivot it in a clockwise direction depicted in Figure 6, so as to bring the driving member 34 into a position for engaging with one of the propelling element driving plates 12b, thereby effecting advancement of the carriage 13 in like manner to the preceding construction.

To enable any one of the carriages 13 to be brought to rest automatically at a pre-determined position along the length of the conveyor the upper forward corner of the two load supporting plates 49, which plates are of inverted triangular form as shown, are joined by a horizontal transversely extending stop pin 52, which stop pin projects laterally to one side of the supporting plates 49 clear also of the suspension plates 27 as shown in Figure 7, and the projecting end of this stop pin is adapted to engage with a similarly laterally disposed abutment plate 53, a number of which abutment plates would be mounted at one side of the track 14 at positions corresponding to those at which a particular carriage is to be stopped.

As shown each abutment plate 53 is supported from a carrier member 54 clamped detachably by screws 55 to the adjacent part of the track, the arrangement permitting of the abutment plates to be mounted in position anywhere as desired along the length of the track in accordance with the requirements of the user. As shown these screws 55 are carried by sleeve like nuts associated with the member 54 and one of these nuts constitutes a vertically extending abutment member 56 depicted most clearly in Figure 9.

Each abutment plate 53 is inclined upwardly in a forward direction; i.e. in the direction of advancement of the conveyor, and has its upper end 57 spaced beneath the track 14 and rearwardly in relation to the adjacent abutment member 56 by a distance in each case sufficient to permit of the passage above and to the front of this end of the abutment plate of the stop pin 52, as will be hereinafter more particularly described.

The configuration of each load supporting plate 49 is such that when the carriage 13 is loaded and is advancing freely, as depicted in Figure 6, the stop pin 52 is disposed a short distance forwardly of the forward edge 58 of the adjacent suspension plate 27 with which forward edge the stop pin 52 is adapted to engage so as to limit its rearward movement in relation to the associated carriage 13 i.e. so as to limit pivotal movement of the load supporting plates 49 in an anti-clockise direction when viewed in Figure 6 relative to the associated carriage 13 and suspension plates 27.

The operation of the arrangement illustrated in Figures 6 to 9 will now be described. In the first place it will be assumed that the carriage loaded by the loaded suspension hook 29 engaging detachably with the load supporting pin 28 is being advanced along the track 14 in the manner already described in connection with the preceding construction with the parts occupying the position depicted in full outline in Figure 6.

As this carriage is advanced by the engagement of the propelling element with the driving member 34 until it reaches the depicted abutment plate 53 the stop pin 52 will engage with the upwardly and forwardly inclined face of this abutment plate and by reason of the continued propulsive force applied to the carriage the load supporting plates 49 are necessarily caused to pivot about their trunnion pin 50 in an anti-clockwise direction relative to the suspension plates 27, the stop pin 52 thereby moving from the running position depicted at 52A up the inclined face of the abutment plate into the loaded stop position depicted at 52B in which it engages with the edge 58 aforesaid of one of these suspension plates, the supporting plates 49 moving accordingly into the position depicted in Figure 8.

By reason of this movement of the supporting plates 49 in relation to the suspension plates 27 the stop spring 45 is increasingly stressed and the stress in the start spring 46 decreased so as to apply to the anchorage plate 44 a torque acting in an anti-clockwise direction sufficient to overcome the torque applied thereto in the opposite direction by the engagement of the now stationary driving member 34 with the still advancing propelling element 12 and the driving member 34 is consequently displaced out of engagement with the previously engaging driving plate 12b, the retarding member 35 being now brought into engagement with a driving plate 12b. Since, however, the propelling element is moving forwardly in relation to the carriage 13 this engagement of retarding member 35 is of no account, and the parts now occupy the stopped loaded position depicted in Figure 8.

On now removing the load by disengaging the suspension hook 29 the tension in the two springs 45, 46 causes the load supporting plates 49 to move upwardly in relation to the suspension plates 27, as is permitted by their slotted connection thereto, and as the stop spring 45 has previously been stressed to an extent greater than that of the start spring 46 a resultant couple will be applied to the supporting plates 49, tending to pivot them in a clockwise direction depicted in Figure 8, so that as the stop pin 52 rises clear of the upper edge 57 of the abutment plate 53 it will ride around the edge of this plate into the intermediate unloaded release position depicted at 52C. As soon as the stop pin 52 is clear of the upper edge of the abutment plate in this way the carriage 13 is perfectly free to be advanced by the very light frictional engagement between the propelling element and the retarding member 35, so that the carriage is advanced slightly in the right hand direction depicted in Figure 8, the pin 52 moving into the finally unloaded position depicted at 52D in which it engages with the abutment member 56 so as thereby to prevent any further movement of the carriage 13.

In this position of the pin 52D the supporting plates 49 have moved upwardly to the fullest extent in relation to the suspension plates 27 and the edge 58 aforesaid of one of these plates occupies the dotted position indicated at 58A in Figure 9 in which it engages with the rear side of the pin 52 when this is in the position depicted at 52D.

When the carriage is again loaded by re-engaging the suspension hook 29 with the supporting pin 28 the pin 52 moves downwardly clear of the underside of the abutment member 56 so that as the supporting pin 28 is still disposed forwardly in relation to the trunnion pin 50 the torque thereby applied to the supporting plates from the suspension hook 29 causes the supporting plates to turn in a clockwise direction, moving the pin 52 forwardly in so doing and at the same time stressing the start spring 46 in relation to the stop spring 45 thereby disengaging the retarding member 35 and re-engaging the driving member 34 so that the parts again move into the position depicted in Figure 6, in which the pin 52 has moved into reloaded stop position depicted at 52E in Figures 8 and 9. The carriage 13 now commences to advance under the engagement of its driving member 34 with the propelling element until again stopped automatically by the engagement of this pin 52 with a further abutment plate 53 in the manner above described.

To take care of the possibility of a following carriage approaching a stationary carriage during its unloading and reloading operation each carriage is provided with a rearwardly directed spacing member 59 carrying on its rear end a spacing plate 60 which is adapted to engage with the abutment pin 52 of the following carriage so as to displace its associated load supporting plate 49 in the anti-clockwise direction above indicated for disengaging its associated driving member 34 from the propelling element and thus to avoid wear or abrasion between the propelling element and the driving member of the following carriage, and it will be appreciated that a whole succession of carriages may be arrested in this way while the forward carriage is at the unloading and reloading position.

As soon as the forward carriage again commences to advance in the manner already described the pressure exerted on the abutment pin 52 of the following carriage is released permitting of the load supporting plates 49 returning to their original position under the weight of the load applied by their suspension hook, thus permitting of re-engagement of the associated driving member 34 with the propelling element and of the following carriage recommencing its advancing movement.

With the construction depicted in Figures 6 to 9 there is accordingly provided an arrangement in which successive carriages are automatically arrested at any predetermined position along the conveyor for unloading purposes and are automatically advanced when reloading of the carriage has been effected, such an arrangement being very convenient in

conveyors for use in assembly and similar operations.

Provision is made for effecting manual arresting of a carriage anywhere along the length of the conveyor by providing the load supporting plates 49 of each carriage with a dependent cord 61 disposed at the side of the plates remote from the abutment pin 52 and it will be appreciated that by pulling the cord the plates are pivoted into a position for effecting disengagement of the driving member 34 from the propelling element 12b.

The retarding member 35, although functioning during the unloading operation in the manner above described serves also as a retarding member in like manner to the member 35 of the construction shown in Figures 3 to 5 and is accordingly referred to as a retarding member with the construction shown in Figures 6 to 9.

What we claim is:—

1. A conveyor of the kind specified wherein each carriage is supported for its advancing movement from a track which is separate from the propelling element itself, each carriage being provided with a propelling element engaging member constituing a driving member, said driving member being mounted on the carriage for pivotal movement in relation thereto about an axis transverse to the direction of advancement of the carriage and being adaped releasably and frictionally to engage with a surface of the propelling element at a position which for the designed direction of advancement of the carriage is situated rearwardly in relation to the said axis of pivoting of the driving member relative to the carriage such that an increase in resistance to the advancement of the carriage tending to retard this relative to the propelling element causes the driving member to turn about its pivot relative to the carriage in a direction to increase the frictional force between it and the propelling element so as thereby to transmit an increased propelling force to the carriage.

2. A conveyor according to Claim 1 provided with a pair of propelling element engaging members, one of which constitutes the said driving member and the other of which constitutes a retarding member, said retarding member being mounted on the carriage for pivotal movement in relation thereto about an axis transverse to the direction of advancement of the carriage and being adapted releasably and frictionally to engage with a surface of the propelling element at a position which for the designed direction of advancement of the carriage is situated forwardly in relation to the axis of pivoting of the retarding member, such that the retardng member is thereby adapted operably to engage with the propelling element when the carriage is tending to move faster than the propelling element so as thereby to inhibit movement of the carriage at a velocity greater than that of the propelling element.

3. A conveyor according to Claim 1 or 2 wherein said driving member has its operative i.e. propelling element engaging surface of convex configuration with the axis of curvature of each part of the convex surface extending in each case parallel to, but to the rear of the axis of pivoting of said member in relation to the designed direction of advancement of the carriage by said driving member.

4. A conveyor according to Claim 3, wherein the shape of the operative surface of the driving member is such that irrespective of the distance between the operative face of the propelling element and the axis of pivoting of the driving member considering these two parts in operative position, the line passing through the line of contact between the driving member and the propelling element on the one hand and the axis of pivoting of the driving member on the other hand is disposed substantially at the angle of friction between the interengaging propelling element and driving member surfaces having regard to the nature of the surfaces of the element and the member with which it engages, for the purpose specified.

5. A conveyor according to Claim 2 or either of Claims 3 and 4 when appendant to Claim 2 wherein displacement of one or the other of said two propelling element engaging members relative to said propelling element is effected by a controlling member operatively connected to each of said propelling element engaging members and adapted for light frictional engagement with the surface of the propelling element in all operative positions of the associated propelling element engaging member, the arrangement being such that relative movement between the propelling element and carriage is transmitted by light frictional engagement through the controlling member to the associated propelling element engaging member for the purpose of bringing one or the other of these two members into operable frictional engagement with the propelling element according to whether acceleration or retardation of the carriage is required.

6. A conveyor according to Claim 5 wherein the two propelling element engaging members are connected together for common pivotal movement in relation

to the carriage and are provided with a single controlling member disposed symmetrically in relation to the said two propelling element engaging members.

7. A conveyor according to Claim 5 or 6 wherein the controlling member is constructed in the form of a stem having moveably mounted thereon an abutment member adapted to be spring displaced into light frictional engagement with the propelling element.

8. A conveyor according to any of the preceding claims including inter-engagable abutment members mounted on the carriage and track, adapted on inter-engagement to effect displacement of the driving member out of engagement with the propelling element for the purpose of arresting the forward movement of a carriage at a predetermined position along the length of the conveyor track.

9. A conveyor according to Claim 8 wherein the conveyor is provided with a load supporting member through which the load is transmitted to the carriage, said load supporting member being displaceable in relation to the carriage under the weight of the applied load and carrying an abutment member adapted when the load is applied to said supporting member to be displaced into a position for engaging with an arresting abutment mounted on the conveyor track, said abutment member being operatively connected to said driving member and being adapted on engagement with said arresting abutment to effect displacement of the driving member out of engagement with the propelling element, said load supporting member being adapted on removal of load therefrom to permit of the abutment member moving out of engagement with said arresting abutment into a position for engaging with a holding abutment mounted on the track so as to retain the driving member out of engagement with the propelling element until the load to be supported is again applied to the load supporting member, the latter being then adapted to be displaced so as to bring its abutment member clear of the holding abutment and the driving member into engagement with the propelling element to permit of further advance of the now loaded carriage.

10. A conveyor according to Claim 9, wherein the load supporting member is mounted for limited substantial vertical movement in relation to the carriage and is further mounted for limited pivotal movement in relation thereto about a substantial horizontal axis transverse to the length of the adjacent track, said driving member being mounted for pivotal movement about an axis parallel to the axis of pivoting of said load supporting member and being connected thereto through the medium of a pair of springs disposed one each side of the line joining the said two pivots, the abutment member being mounted on said load supporting member and the arrangement being such that when the abutment member engages with the arresting abutment the load supporting member is pivoted in a direction to increase the stress in one of the two springs acting in a direction to effect disengagement of the driving member from the propelling element, the load supporting member being adapted on reloading of the carriage following the aforesaid removal of the load to be displaced in a direction for oppositely stressing the said springs to effect re-engagement of the driving member with the propelling element and displacement of the abutment member into a position clear of said holding abuement.

11. A conveyor according to any of Claims 8 to 10 wherein each carriage is provided with means for engaging with the abutment member on the following carriage so that when the first carriage is arrested successive carriages are successively arrested by engagement of each of their abutment members in turn to effect displacement of their driving member out of engagement with the propelling element.

12. A conveyor according to any of the preceeding claims including manually operable means for effecting disengagement of the driving member from the propelling element at any desired position along the length of the conveyor track.

13. A conveyor substantially as hereinbefore described with reference to and as shown in Figures 1 and 2 of the accompanying drawings.

14. A conveyor substantially as hereinbefore described with reference to and as shown in Figures 3 to 5 of the accompanying drawings.

15. A conveyor substantially as hereinbefore described with reference to and as shown in Figures 6 to 9 of the accompanying drawings.

Dated this 25th day of June, 1953.
FORRESTER, KETLEY & CO.,
Chartered Patent Agents,
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Jessel Chambers, 88/90, Chancery Lane,
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PROVISIONAL SPECIFICATION
No. 9031, A.D. 1952.

Improvements in or relating to Conveyors for Goods

We, FISHER & LUDLOW LIMITED, a British Company, of Bordesley Works, Clyde Street, Birmingham, 12, in the County of Warwick, do hereby declare this invention to be described in the following statement:—

This invention relates to conveyors of the kind comprising an elongated propelling element such as, for example, a flexible belt or band or a chain carrying a series of closely spaced transversely extending slats, and one or more goods or article supporting carriages provided with supporting wheels, rollers or the equivalent and adapted to be advanced by said propelling element to predetermined positions in which they are required temporarily to be brought to rest.

Such conveyors are used, for example, in assembly operations in which a succession of such carriages are advanced past a number of operators who are required to perform different assembly operations on the article or articles supported by each carriage, the carriages being consequently required to be brought temporarily to rest at such positions, and is so far as at different operating stations the period for which the carriages are required to be at rest varies, such can only be effected by stopping the carriages themselves without stopping the continued advancement of the propelling element which is itself usually an endless belt.

Hitherto as far as we are aware the carriages have been provided with supporting wheels which engage with the upper surface of the belt or other propelling element, the lower surface of which has been supported by a skid plate the arrangement being such that the carriages are advanced bodily by the belt without rotation of the wheels so long as they are not subjected to an external retarding force, while on applying such retarding force to a particular carriage so as to bring it to rest the wheels then rotate under the continued forward movement of the belt or other propelling element:—

With such an arrangement the whole of the weight of each carriage with its associated load is transmitted through the belt to the supporting skid plate, or if the belt is not supported by a skid plate but is supported by rollers or other supports spaced at intervals along the length of the conveyor, the belt or other propelling element will itself be displaced downwardly by the applied load so that a very substantial retarding force will be applied to the belt or other propelling element by each loaded carriage, which force in the case where the belt or other propelling element is supported on skid plates will be a frictional force between the under side of the belt and the skid plate proportional to the weight of the carriage and its associated load and in practice when the carriage is being advanced such force is likely to be approximately 50% of the weight of the advancing carriage with its associated load.

Further when the carriage with its associated load is brought to rest by the application of an external retarding force, the retarding force acting on the belt will be increased still further by a value corresponding to this retarding force.

Such an arrangement is open, therefore, to the following two serious objections:—

(a) The belt is subjected both when the carriage is advancing as well as when it is stationary to a very substantial retarding force which may be of the order of 50% to 60% of the weight of the carriage and its associated load.

(b) By reason of the weight being transmitted from each loaded carriage through the belt to its supporting skid plate the under side of the belt is subjected to very considerable wear arising from the friction between the under side of the belt and the skid plate.

In consequence, where a substantial number of carriages are provided particularly where these are required to carry heavy loads, belts of enormous strength are necessary if they are to transmit the required load without breaking with consequent very substantial addition to both the initial as well as the replacement cost of the conveyor, while power required to drive the belt is itself substantial, calling for the provision of an electric motor or other power unit and its associated equipment of relatively large size. Further the relatively frequent replacement of the belt arising from the wear aforesaid increases still further the replacement costs of such a form of conveyor installation.

The present invention has for its object the provision of an improved arrangement in which the foregoing serious disadvantages are at any rate largely eliminated.

According to the present invention each carriage is supported through supporting wheels, rollers or the equivalent from a

stationary track having a propelling element engaging surface displaceable in relation to said propelling element and adapted releasably and frictionally to engage the adjacent surface of the propelling element with a pressure which increases with increase in loading of the carriage, the arrangement being such that an increase in the resistance to advancement of the carriage corresponding to an increase in loading thereof is accompanied by an increase in the frictional force between the propelling element and the propelling member for advancing the carriage, while at least a substantial proportion of the mass of the loaded carriage is transmitted directly to the track through the supporting wheels, rollers or the equivalent instead of being transmitted through the belt or other propelling element.

Preferably, the amount of the mass of the loaded carriage supported by the track is a major proportion of the entire mass and the arrangement may be such that a saving of 90% may be effected in the propulsive force required to advance each carriage, such saving arising, of course, from the fact that the carriage is now supported by a stationary track with only a proportion of the weight of the loaded carriage being applied to the belt or other propelling element through the propelling member aforesaid.

Preferably, the propelling member is mounted on the carriage for pivotal movement about an axis transverse to the direction of advancement of the carriage and is adapted to engage with the propelling element at a position rearwardly in the direction of advancement of the pivot so as to provide a toggle wedge frictional engagement with the propelling element, the arrangement being such that increase of resistance to advancement of the carriage by the belt causes the propelling member, where it engages with the belt or other propelling element, to advance forwardly in relation to the carriage to raise the adjacent part of the carriage relative to the belt or other propelling element, thereby increasing the pressure between the propelling member and the propelling element with consequent increase in the frictional force acting between the propelling member and the propelling element.

The propelling member preferably has said surface of arcuate form with its centre of curvature to the rear of the axis of pivoting of the member and the arrangement may be such that the radius line joining the position of contact with the propelling element to the axis of pivoting of the propelling member is in operation substantially at the angle of friction to the adjacent surface of the propelling element having regard to the nature of the surface of the element and the member with which it engages.

In one particular construction as applied to an endless belt conveyor of the type embodying a rubber or canvas belt running on skid plates which are either horizontal or inclined at a small angle to the horizontal so as to support the belt continuously or substantially continuously on the under side along the length thereof, the belt would have a width substantially less than the width of the supporting skid plates so as to provide at opposite longitudinal edges of the belt a track.

Each carriage would comprise a load supporting platfrom or the equivalent and be provided with a front and rear pair of supporting wheels, two wheels in each pair being spaced apart by a distance appreciably greater than the width of the belt so that each wheel is supported directly from the track aforesaid instead of engaging with the upper surface of the belt as in the hitherto known construction.

The forward end of each carriage would be provided with a horizontal transversely extending trunnion extending parallel to the axes of rotation of the two pairs of supporting wheels, this trunnion pivotally supporting for movement about such axis a propelling member conveniently constructed in the form of a shoe of arcuate configuration so as to present on its under side a face which is convex about an axis to the rear of the axis of pivoting of said member, such member being so shaped having regard to the dimensions of the carriage as to engage with the upper surface of the belt at a position spaced rearwardly in relation to said pivotal axes. For instance where the pivotal axis is spaced approximately 7″ above the upper surface of the belt the position of engagement between the surface of the propelling member and the belt may be approximately 5½″ to the rear of a vertical transverse plane passing through the pivotal axis of the propelling member aforesaid.

The actual shape of the operative surface of the shoe is preferably such that for all vertical displacments of the upper surface of the belt in relation to the axis of pivoting of the propelling member shoe, the angle made by a line joining the point of contact between the shoe and the belt and the axis of pivoting is approximately 35° to 40° in relation to a vertical transverse plane passing through said axis of pivoting, such an arrangement ensuring optimum frictional engagement between the propelling member surface and the belt despite variations in belt thickness. i.e. in the height of the upper surface of

the belt in relation to the track carrying the carriage supporting wheels.

The operative surface of the propelling member shoe is formed of a material having a high co-efficient of friction at its surface, for example, it may comprise brake lining material, a plastic or a ribbed rubber strip.

The propelling member may carry an arm or other part whereby it may be displaced manually or, if desired, by a mechanically or electrically operated selected member in a rearward direction relative to the carriage out of engagement with the belt so as to bring the carriage to rest at a predetermined position and where, for example, a succession of carriages are being advanced past the operator at an assembly position in an assembly conveyor installation, such arm or other part may project forwardly beyond the front of its associated carriage so that when the latter is advanced up to an already stationary carriage at such assembly position it engages with the rear end of such already stationary carriage so as to displace its associated propelling member rearwardly out of engagement with the belt thereby bringing the next advancing carriage to rest.

In a particular test in which a single carriage was advanced firstly by supporting it through its supporting wheels on an advancing belt as of the hitherto known arrangement, a propelling force of approximately 23 to 24 lbs. had to be applied to the belt to advance the carriage, while when the same carriage was placed on a narrower but otherwise identical belt so as to be advanced in accordance with the present invention a propelling force of only 3 lbs. was required to be applied to the belt before the carriage commences to advance, thus it will be appreciated that with the present invention the saving in belt loading and thus in belt strength size cost is most substantial, while there is further a substantial saving in belt wear as well as in the power required for driving the belts.

Further when the carriage is brought to rest in accordance with the present invention no retarding force whatsoever is being applied by the carriage to the belt instead of an increased retarding force being applied as in the hitherto known arrangement.

Further with the particular form of propelling member above described this has a wedge toggle frictional engagement with the upper surface of the belt, that is to say, and increased resistance to forward movement of the carriage causes the operative surface of the propelling member to tend to move forwardly in relation to the carriage and thus by reason of the fact that such operative face has its axis of curvature spaced rearwardly in relation to its axis of pivoting, the forward movement of the propelling member tends to raise the adjacent part of the carriage off the adjacent supporting wheels, thereby applying an increased downward pressure between the propelling member and the belt which automatically compensates for any tendency to slip arising from the increase in external resistance to the advancement of the carriage by the belt.

In an alternative arrangement the propelling member may be constructed in the form of a leaf or the equivalent spring and the carriage may be spring supported on the adjacent pair of supporting wheels, the arrangement being such that increase in load on the carriage is accompanied by a downward displacement of the carriage in relation to such pair of supporting wheels against the loading provided by the spring support, such downward displacement causing the propelling member spring to be stressed to a greater extent so as to apply a greater spring pressure to the upper surface of the belt corresponding to such increase in loading of the carriage. Such propelling member spring would be of relatively light and flexible configuration so as only to apply a relatively small downward load to the belt when the carriage was unloaded.

Conveyors embodying the present invention are capable of advancing the carriages up relatively easily graded inclines to the horizontal, for example, inclines of the order of 20° to 30° to the horizontal in addition, of course, to advancing the carriages along a horizontal level as would normally be the case in assembly operations.

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PROVISIONAL SPECIFICATION
No. 13632, A.D. 1952.

Improvements in or relating to Conveyors for Goods

We, FISHER & LUDLOW LIMITED, a British Company, of Bordesley Works, Clyde Street, Birmingham 12, in the County of Warwick, do hereby declare this invention to be described in the following statement:—

This invention relates to conveyors of the kind comprising an elongated propel-

ling element such as, for example, a flexible belt or band or a chain carrying a series of closely spaced transversely extending slats, and one or more goods or article supporting carriages adapted to be advanced by said propelling element to predetermined positions in which they are required temporarily to be brought to rest.

Such conveyors are used, for example, in assembly operations in which a succession of such carriages are advanced past a number of operators who are required to perform different assembly operations on the article or articles supported by each carriage, the carriages being consequently required to be brought temporarily to rest at such positions, and in so far as at different operating stations the period for which the carriages are required to be at rest varies, such can only be effected by stopping the carriages themselves without stopping the continued advancement of the propelling element which is itself usually an endless belt.

Hitherto as far as we are aware the carriages have been provided with supporting wheels which engage with an upwardly directed surface of the belt or other propelling element, the lower surface of which has been supported by a skid plate, the arrangement being such that the carriages are advanced bodily by the belt without rotation of the wheels so long as they are not subjected to an external retarding force, while on applying such retarding force to a particular carriage so as to bring it to rest the wheels then rotate under the continued forward movement of the belt or other propelling element.

With such an arrangement the whole of the weight of each carriage with its associated load is transmitted through the belt to the supporting skid plate, and while if the belt is not supported by a skid plate but is supported by rollers or other supports spaced at intervals along the length of the conveyor, the belt or other propelling element will itself be displaced downwardly by the applied load so that a very substantial retarding force will be applied to the belt or other propelling element by each loaded carriage, which force in the case where the belt or other propelling element is supported on skid plates will be a frictional force between the under side of the belt and the skid plate proportional to the weight of the carriage and its associated load and in practice when the carriage is being advanced such force is likely to be approximately 50% of the weight of the advancing carriage with its associated load.

Further, when the carriage with its associated load is brought to rest by the application of an external retarding force, the retarding force acting on the belt will be increased still further by a value corresponding to this retarding force.

Such an arrangement is open, therefore, to the following two serious objections.

(a) The belt is subjected both when the carriage is advancing as well as when it is stationary to a very substantial retarding force which may be of the order of 50% to 60% of the weight of the carriage and its associated load.

(b) By reason of the weight being transmitted from each loaded carriage through the belt to its supporting skid plate the under side of the belt is subjected to very considerable wear arising from the friction between the under side of the belt and the skid plate.

In consequence, where a substantial number of carriages are provided particularly where these are required to carry heavy loads, belts of enormous strength are necessary if they are to transmit the required load without breaking with consequent very substantial addition to both the initial as well as the replacement cost of the conveyor, while the power required to drive the belt is itself substantial, calling for the provision of an electric motor or other power unit and its associated equipment of relatively large size. Further, the relatively frequent replacement of the belt arising from the wear aforesaid increases still further the replacement costs of such a form of conveyor installation.

One of the objects of the present invention is the provision of an improved arrangement in which the foregoing serious disadvantages are at any rate largely eliminated.

A further object of the present invention is to provide a generally improved arrangement of conveyor of the foregoing kind in which the carriages can be brought temporarily to rest as required by the operator while at the same time the propelling element is allowed to continue its motion.

According to the present invention each carriage is supported for an advancing movement from a track separate from the propelling element itself and each carriage is provided with a propelling element engaging member which is displaceable in relation to the said propelling element and is adapted releasably and frictionally to engage a surface of the propelling element with an engaging pressure which increases with increase in

resistance to advancement of the carriage, the arrangement being such that increase in resistance to advancement of the carriage is accompanied by an increase in the frictional force between the propelling element engaging member and the propelling element so that the carriage may still be propelled by frictional engagement between the propelling element engaging member and said propelling element.

For example, the propelling element engaging member may be mounted for angular movement relative to the carriage about an axis which is transverse to the direction of advancement of the adjacent part of the propelling element which said member engages, the arrangement being such that increase in the resistance to movement of the carriage with consequent corresponding increase in the force acting between the propelling element and said member in the direction of movement of said element at such position applies a force to said member tending to displace it in a direction towards the surface of the propelling element with which it engages.

Such a fact follows from the fact that any increase in resistance to advancement of the carriage will necessarily be accompanied by a corresponding increase in the frictional force acting between said member and the propelling element in the direction of advancement of said element and by suitably disposing said member this force may be utilized to displace said member in a direction towards the propelling element so as to apply an increased engaging pressure thereto and thus preclude slip between said member and the propelling element despite the increase in the resistance to advancement of the carriage, for example, as a result of increased loading of the carriage, or as a result of the carriage being advanced upon an upwardly sloping track, or upon a track the upward slope of which is increasing.

The invention may be applied to the particular arrangement described in our prior Provisional Specification No. 9031/52, in which the carriages are disposed above a propelling element in the form of an endless belt or band, or a chain carrying a series of closely spaced transversely extending slats in which the carriage is supported upon a track separate from but closely adjacent to the propelling element.

The invention may however, be further applied to conveyors wherein the propelling element takes the above form but in which the track is spaced an appreciable distance either above or below the propelling element. For example, the track and the carriages themselves may be of the general form described in our prior United Kingdom Patent Specification Nos. 639244 and 639249, in which, however, each carriage would comprise a single pair of links connected together at each end by a connecting body, each body being provided with two pairs of track engaging wheels or rollers rotatable about mutually perpendicular axes for engaging with the track as described in the foregoing two Specifications, particularly No. 639,244.

In such an arrangement the goods may either be supported from beneath each carriage or each carriage may be provided with upwardly projecting goods supporting means for engaging the goods and advancing the same.

In one specific arrangement the conveyor may have the particular form described in our Provisional Specification No. 13633/52 of even date, with each carriage provided with two oppositely directed propelling element engaging members each having a cam surface for engaging with said members, two such members being provided for the specific purpose described in such specification.

Alternatively, only one such member may be provided, with the spring loaded stroking finger omitted so that the device functions exactly in the manner above described, that is to say, with increase in resistance to the advancement of the carriage, the propelling element engaging member having the cam surface is displaced in a direction relative to the propelling element for applying an increased engaging pressure thereto, whereby an increased carriage advancing force is transmitted frictionally between the propelling element and the carriage to be thereby advanced.

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PROVISIONAL SPECIFICATION
No. 13633, A.D. 1952.

Improvements in or relating to Conveyors for Goods

We, FISHER & LUDLOW LIMITED, a British Company, of Bordesley Works, Clyde Street, Birmingham, 12, in the County of Warwick, do hereby declare

this invention to be described in the following statement:—

This invention relates to conveyors of the kind comprising an elongated propelling element such as, for example, a flexible belt or band or a chain carrying a series of closely spaced transversely extending slats, and one or more goods or article supporting carriages and provided with means adapted frictionally to engage with a surface of the elongated propelling element so as thereby to effect advancement of the carriage

The invention is applicable to conveyors of the foregoing kind in those particular circumstances in which variation in the velocity of the carriage in relation to that of the propelling element is liable to occur and it is desired to control such variations.

One such particular circumstance is the case where the carriages are being advanced in either a substantially horizontally direction or in a direction which is inclined upwardly to the horizontal and in both cases at a predetermined velocity and it is required to advance the carriage in a direction which is inclined downwardly to the horizontal so that there is a danger of the carriage accelerating gravitationally, which gravitational acceleration may be undesirable.

A further example of such a circumstance to which the present invention is applicable is the case in an assembly operation for which a succession of carriages are required to pass different assembly positions at different speeds being driven past such positions by separate propelling elements advancing at different corresponding velocities, the carriages passing successively from a faster to a slower moving position and it is desired immediately to retard the velocity of the carriages as they pass from the faster to the slower moving propelling element.

According to the present invention we provide each carriage with a pair of propelling element engaging means each adapted frictionally to engage with the propelling element, one of said means being adapted operably to engage with the element when the carriage is tending to move at a slower rate than that of the element thereby to effect advancement of the carriage at a speed corresponding to that of the propelling element and the other of said two members being adapted to operably engage with the propelling element when the carriage is tending to move faster than the propelling element so as thereby to inhibit movement of the carriage at a velocity greater than that of the propelling element.

Displacement of one or the other of said two element engaging members may be effected by one or more displacing members, the or each such displacing members being operatively connected to the or one of the engaging members respectively as well as with the carriage and adapted for light frictional engagement with a surface of the propelling element in all operative positions of the associated engaging member or members, the arrangement being such that relative movement between the propelling element and carriage is transmitted by light frictional engagement through the displacing member or members to the associated engaging member or members for the purpose of bringing one of the other of these members into operable frictional engagement with the propelling element for the purpose above described.

By the expression "light frictional engagement" is meant herein frictional engagement of such a nature as to effect actuation of the operating member without being sufficient to transmit a significant propelling force therethrough from the propelling element to the carriage.

In the above arrangement a single operating member would be provided connected to the two engaging members and these two members together with the operating member would all be mounted for pivotal movement in unison on the carriage about an axis transverse to the direction of advancement of the carriage, the propelling element engaging part of the operating member being conveniently disposed symmetrically in relation to the said two engaging members.

Preferably each of the said engaging members would be adapted releasably and frictionally to engage with the surface of the propelling element with an engaging pressure which increases with increase in resistance to advancement of the carriage, the arrangement being such that increase in resistance to advancement of the carriage is accompanied by an increase in the frictional force between such propelling element engaging member and the propelling element so that the carriage may still be propelled by frictional engagement between the propelling element engaging member and said propelling element, i.e., as described in our prior Provisional Specification No. 9031/52 and as further described in our Provisional Specification No. 13632/52 of even date.

The propelling element engaging part of the operating member or the operating member as a whole would preferably be spring loaded or spring supported in

relation to the carriage in such a manner as to ensure that the light frictional engaging pressure between it and the propelling element remained substantially constant for all positions of engagement between such operating member and the propelling element.

The propelling element engaging members would preferably have cam or other specially shaped surfaces for engaging with the propelling element for the purpose of effecting the aforesaid increase in engaging pressure between any one of these two members and the propelling element in consequence of increasing resistance to advancement of the carriage.

The invention may be applied to an arrangement in which, as described in our prior Provisional Specification No. 9031/52 the carriages are disposed above a propelling element in the form of an endness belt or band, or a chain carrying a series of closely spaced transversely extending slats in which the carriage is supported upon a track separate from but closely adjacent to the propelling element.

The invention may, however, be further applied to conveyors wherein the propelling element takes the above form but in which the track is spaced an appreciable distance either above or below the propelling element. For example, the track and the carriages themselves may be of the general form described in our prior United Kingdom Patent Specification Nos. 639,244 and 639,249 in which, however, each carriage would comprise a single pair of links connected together at each end by a connecting body, each body being provided with two pairs of track engaging wheels or rollers rotatable about mutually perpendicular axes for engaging with the track as described in the foregoing two specifications, particularly No. 639,244.

In such an arrangement the goods may either be supported from beneath each carriage or each carriage may be provided with upwardly projecting goods supporting means for engaging the goods and advancing the same.

In one specific form of this latter arrangement the connector plates for supporting the cruciform section track of the general configuration illustrated in the said Specification No. 639,249 would as illustrated in Figure 3 of that specification, be provided with means similar to the guide elements 38, 39 and formed from a single thickness of sheet metal for supporting a propelling element in the form of an endless belt so that the opposite edges of the belt were supported by in-turned flanges similar to those of the parts 38, 39 of the prior specification whereby the belt is supported at a fixed height above the track for movement in a direction parallel to the length of the adjacent part of the track.

The two links of the single pair of links of each carriage constructed as above describeod would be connected together at two positions spaced symmetrically longitudinally on opposite sides of the centres of the links by pins carrying distance sleeves which extend between the opposed faces of the links, each distance sleeve having mounted thereon a pair of plates which may be of somewhat elongated triangular form, the upper part of each plate extending between the two links with the plates parallel to the two links, the plates depending by an appreciable distance below their associated carriage and being connected together at their lower end by a load supporting pin.

The two plates are further connected at a position which may be horizontally equi-distant between the two distance sleeves aforesaid by a pivot pin upon which pivot pin the two propelling element engaging members and a single associated operating member therefore are amounted upon the aforesaid pivot pin for pivotal movement relative to the carriage and propelling element about an axis extending horizontally at right angles to the direction of movement of the propelling element and carriage.

Conveniently each engaging member is constructed in the form of a strip metal arm, the two arms of which are connected rigidly together through the medium of a part-circular bearing member which engages with the said pivot pin, the two arms diverging relatively from their point of connection and being bent in opposite directions at their outer ends in directions which are substantially longitudinal of the propelling element, the oppositely bent portions carrying friction lining material which presents in each case a curved surface for engaging with the adjacent under side of the belt, with each lining surface convex about one of two corresponding axes parallel to the axis of the pivot pin, the arrangement being such that when the belt is advanced in relation to the carriage in one or the other direction, one or the other of these two engaging members is displaced frictionally by its engagement with the belt in a direction for applying an increased frictional pressure from such member on to the belt so as to increase the force applied to the carriage therethrough for advancing the carriage in such direction

of advancement of the belt in relation to the carriage.

The semi-circular bearing member carries symmetrically between the two mutually diverging arms an operating member comprising a tubular part, one end of which is secured to the semi-circular bearing and having slidable therein a stem the outer end of which is formed as an operating finger adapted either for point engagement at its outer end with the under side of the belt, or for engagement therewith about a line extending perpendicular to the direction of advancement of the belt, a very light spring acting between a shouldered part of the stem and an abutment within a tubular portion so as to maintain the finger of the operating member in light frictional engagement with the belt irrespective or variation in the angular position of said member.

The arrangement is such that normally only one of the two belt engaging members is in engagement with the under side of the belt with the operating member in such position inclined either forwardly or backwardly in relation to the direction of advancement of the belt instead of being perpendicular thereto and if, for example, the carriage is being propelled at a constant rate by the belt in the general manner described in our two provisional specifications aforesaid and the carriage commences to accelerate in relation to the belt, for example, gravitationally as a result of the carriage descending an incline in the conveyor installation, the engaging member which is in operative engagement with the belt will under the acceleration of the carriage tend to move out of engagement with the belt thereby pivoting itself and the operating member and the other engaging member in unison in one angular direction relative to the carriage until it is out of operative engagement with the belt, whereupon only the operating member itself is in engagement with the belt.

In consequence of this continued engagement of the operating member with the belt, the other belt engaging member is now brought into engagement with the belt by reason of this continued advancement of the carriage relative to the belt which other operating member by reason of its oppositely directed belt engaging surface acts in a direction for inhibiting further relative movement of the carriage in relation to the belt so that the carriage velocity is immediately reduced to that of the belt and undesirable gravitational acceleration of the carriage avoided.

When the resistance to the forward movement of the carriage exceeds the gravitational forward force thereon so that the carriage tends to move in the opposite direction in relation to the belt, the operating member and the two engaging members are pivoted similarly in the opposite direction so that the carriage is still advanced at belt speed.

Instead of pivoting, the engaging members together about a common axis, they may be pivoted about separate axes disposed, for example, at opposite ends of the carriage and connected together by a link which may be in the form of a light bowed spring link carrying the operating member, such an arrangement ensuring that the operating member engages the belt with a substantially constant spring pressure irrespective of substantial variation in its angular position. In such an arrangement ensuring that the operating member engages the belt with a substantially constant spring pressure irrespective of substantial variation in its angular position. In such an arrangement the operating member may again be made in two parts slidable one within the other, one part being pivoted to the carriage substantially centrally of the length thereof and the other part being slidable through a guide provided on the bowed spring link.

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FIG.1.

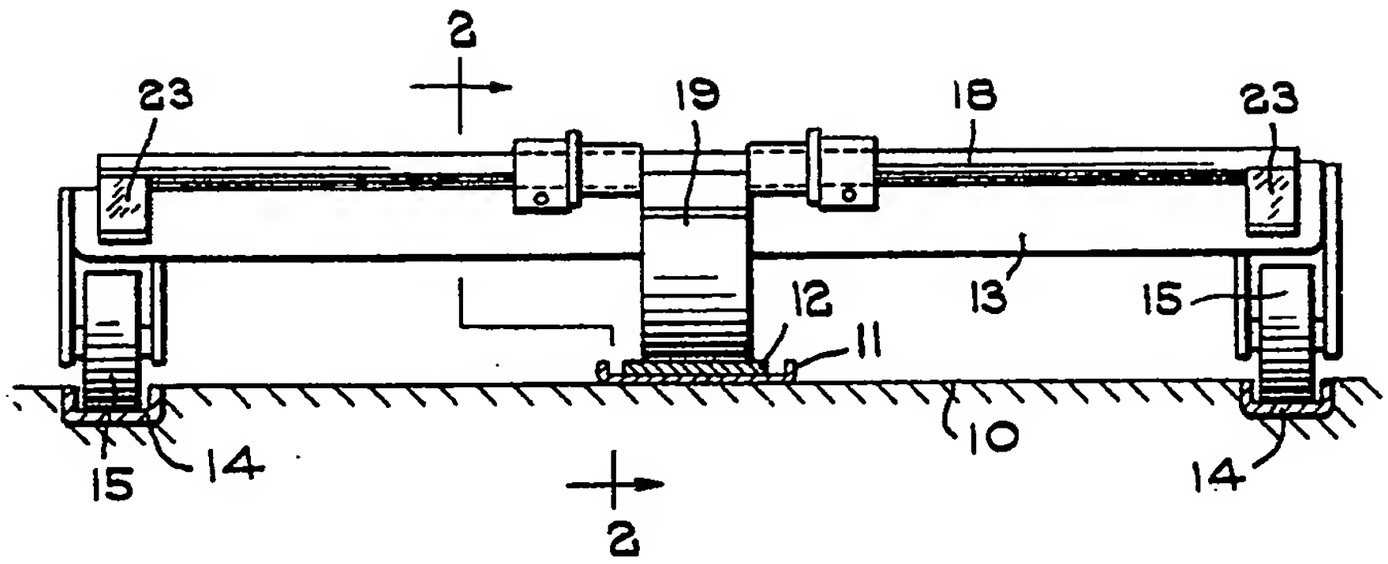
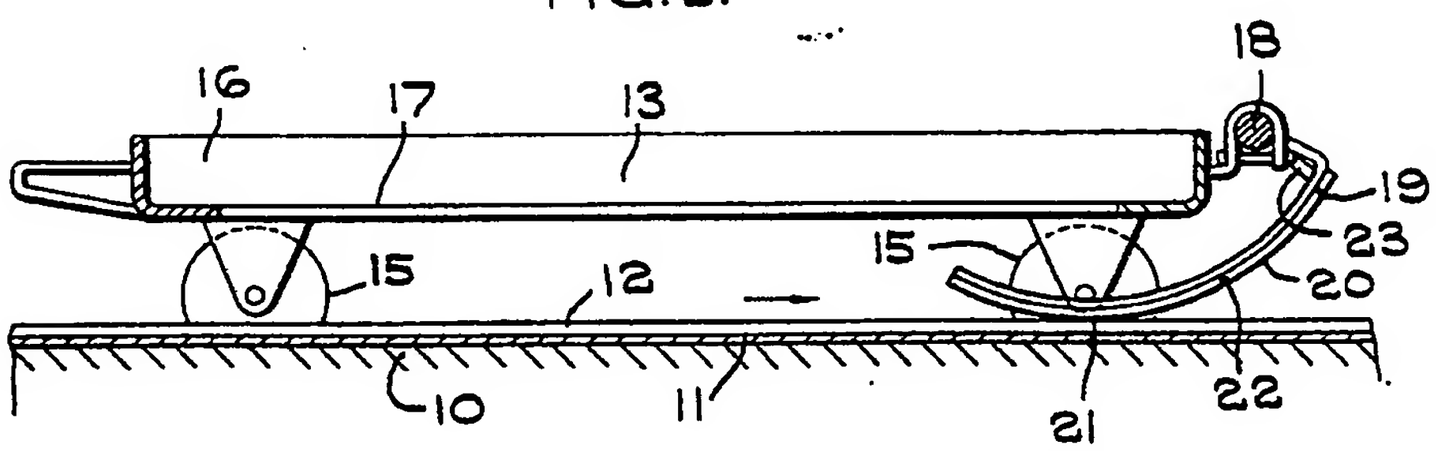


FIG.2.



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3 SHEETS

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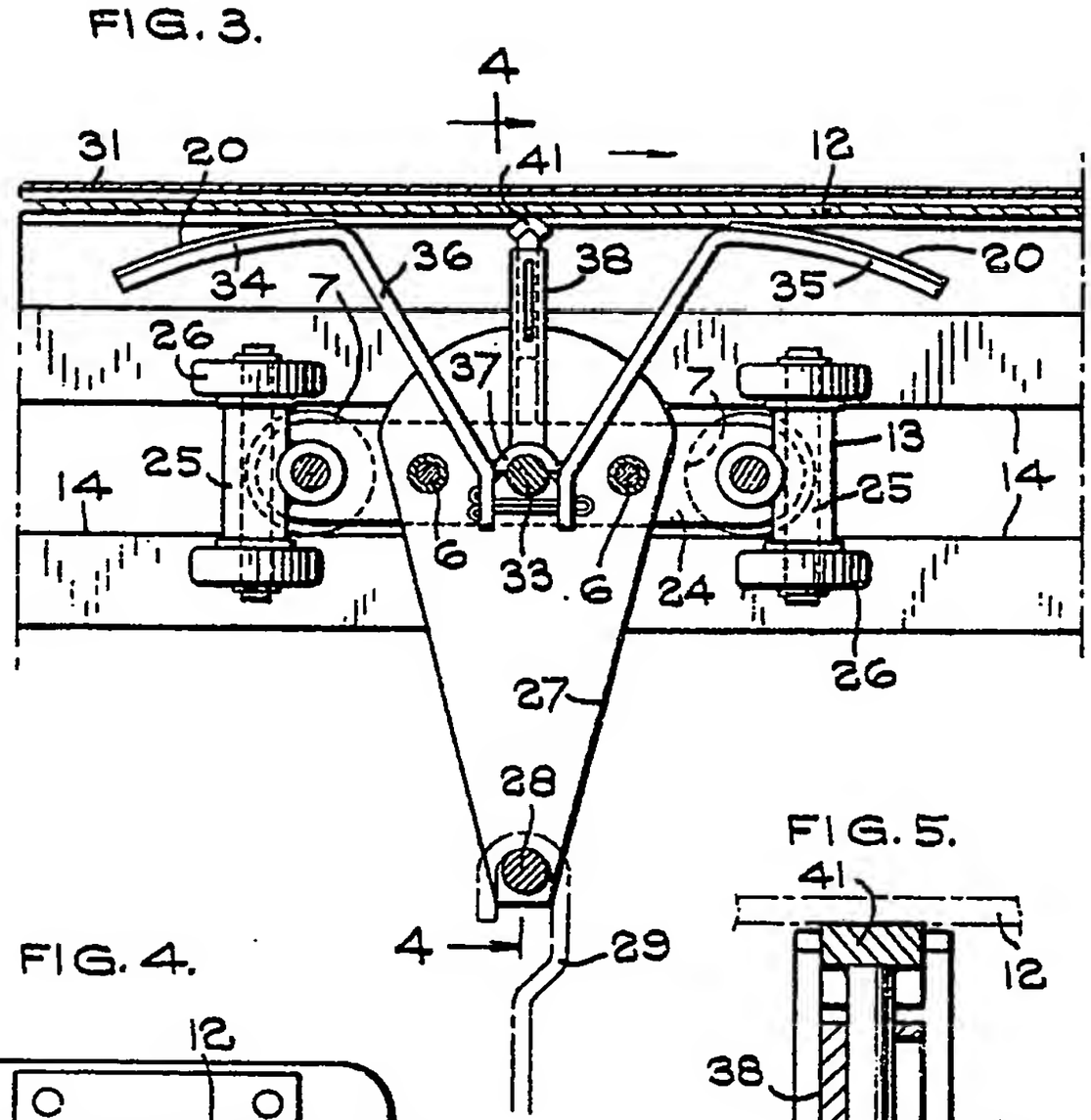
SHEETS 1 & 2

FIG. 3.



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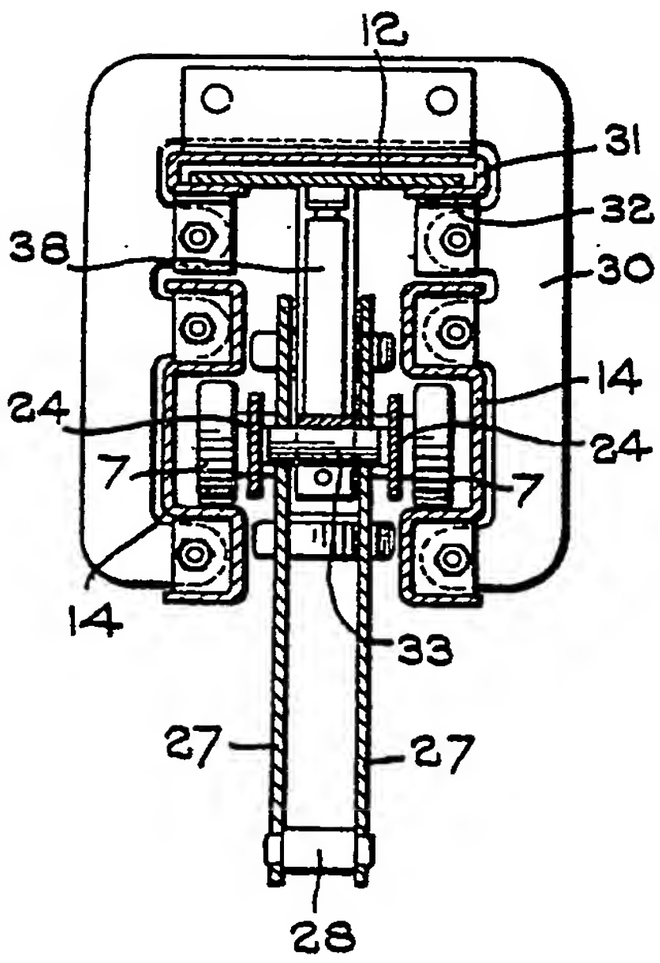
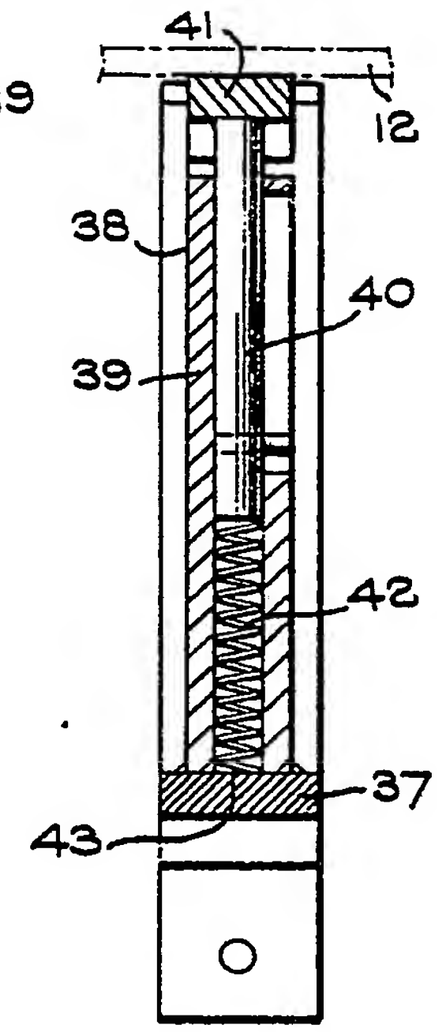


FIG. 5.



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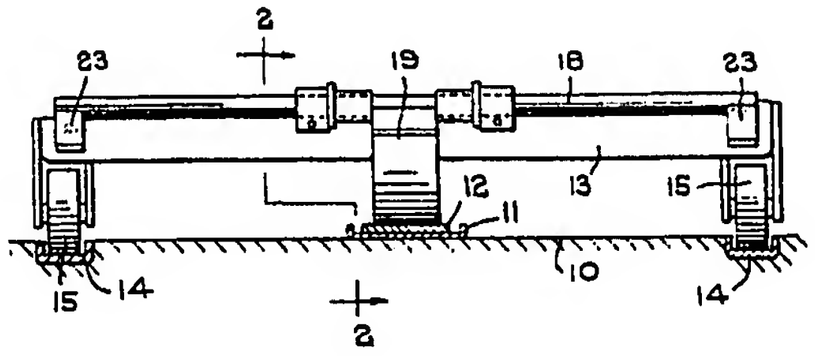
SHEETS 1 & 2

FIG.1.



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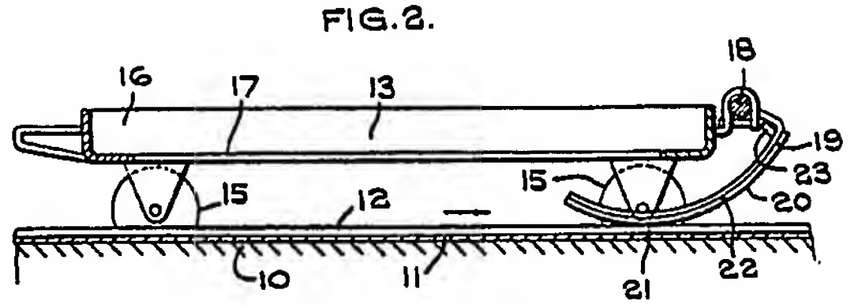

FIG.3.

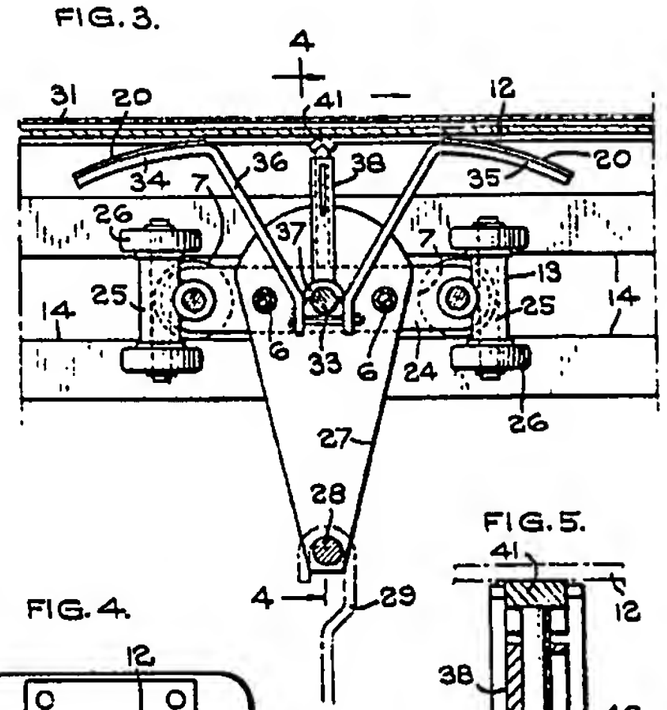

FIG.4.

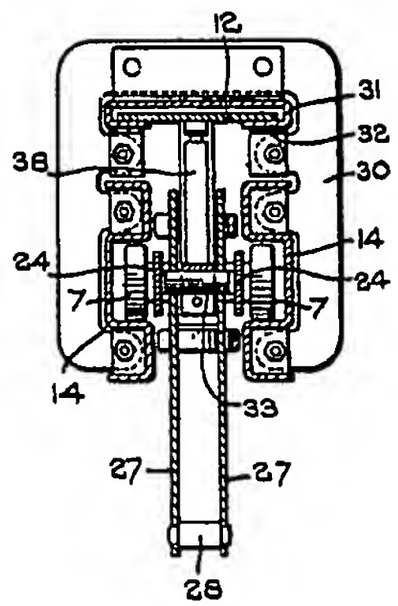

FIG.5.

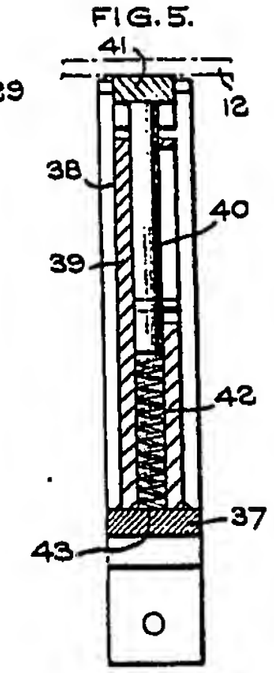

FIG. 6.

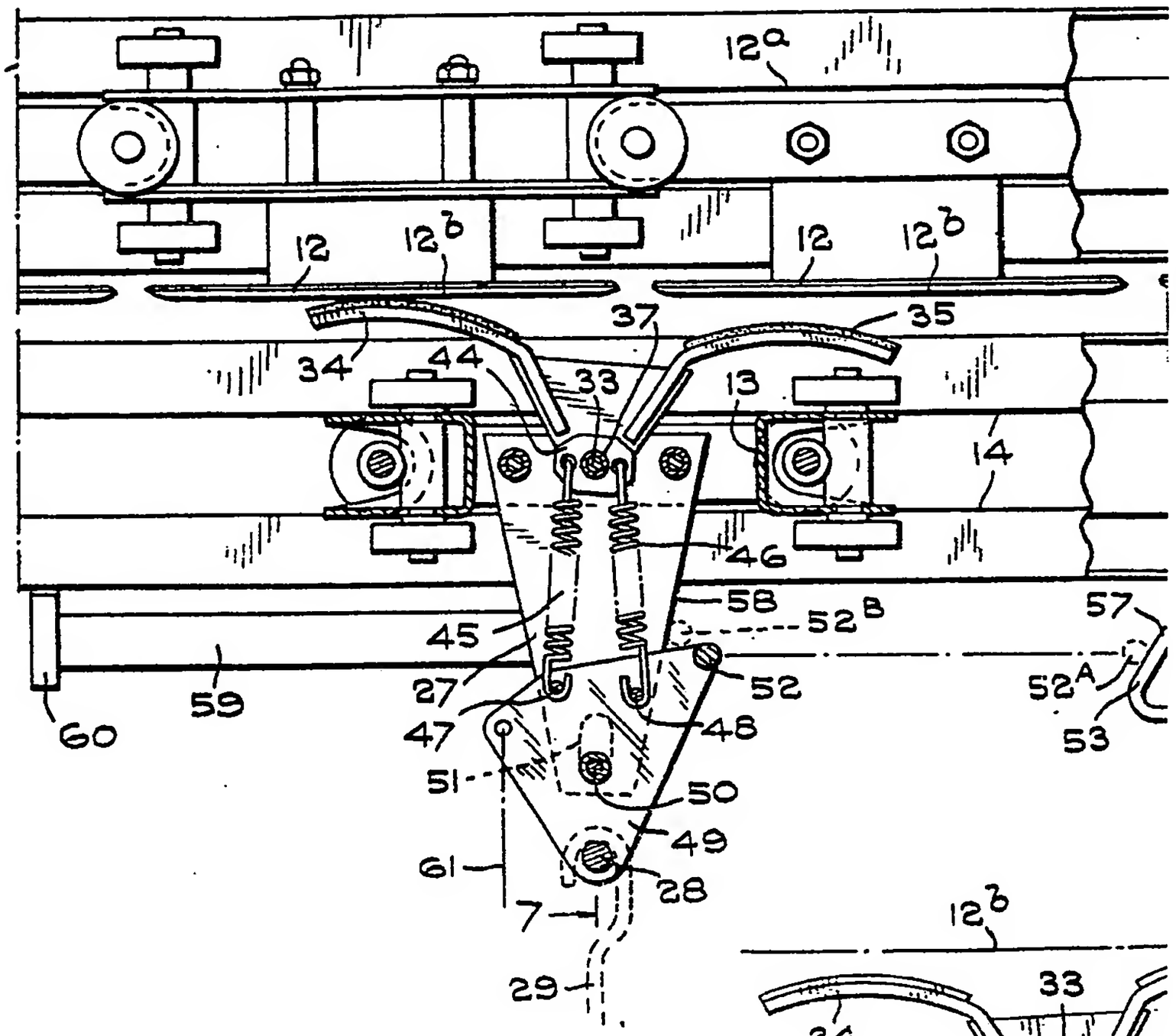
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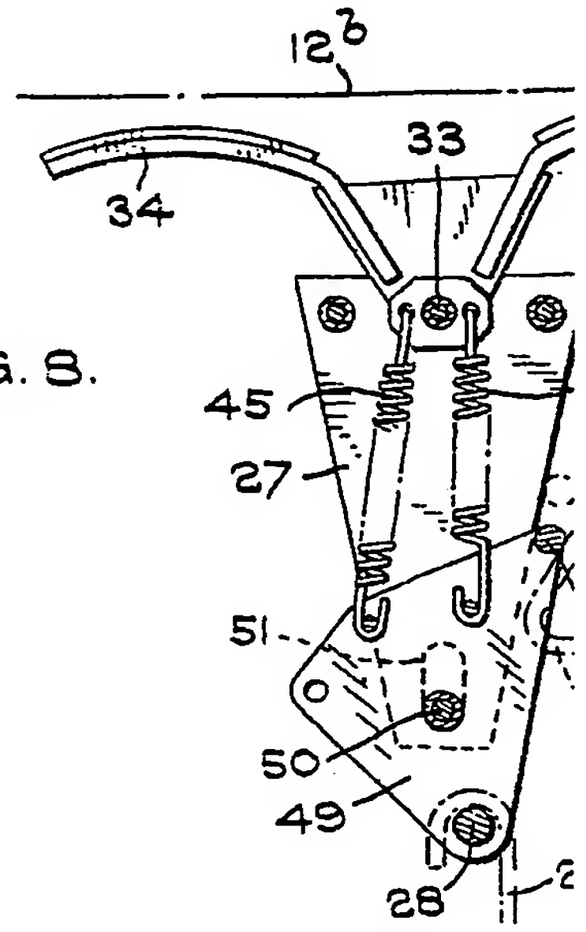
FIG. 8.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3 SHEETS

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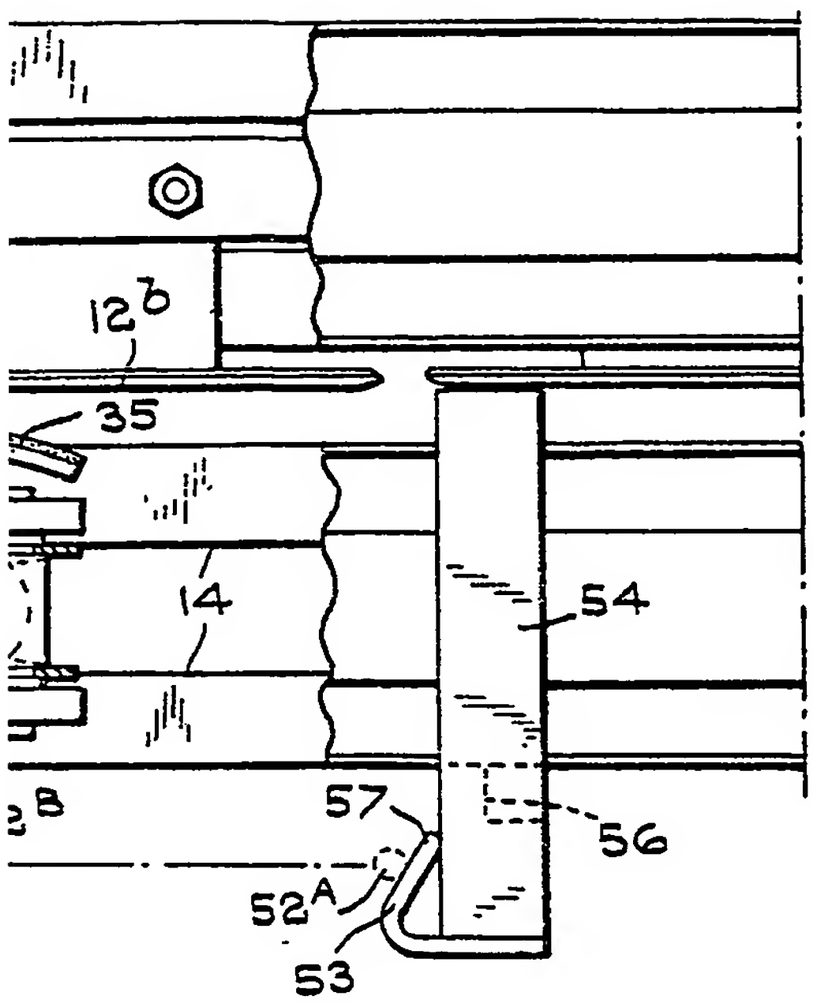
SHEET 3

FIG.7.



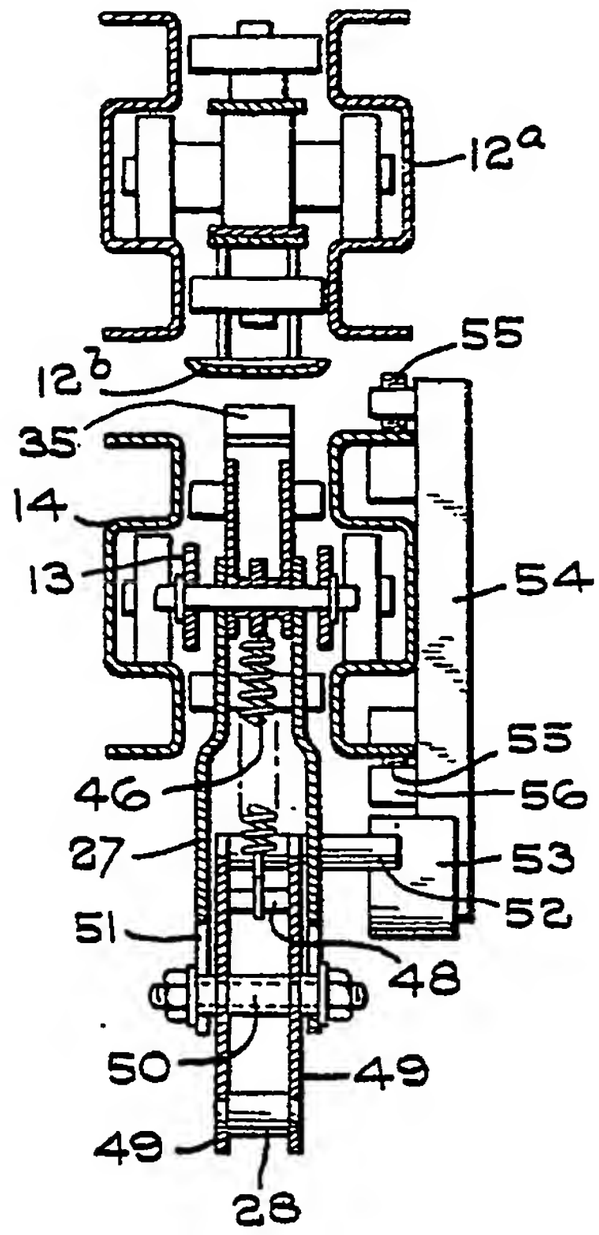
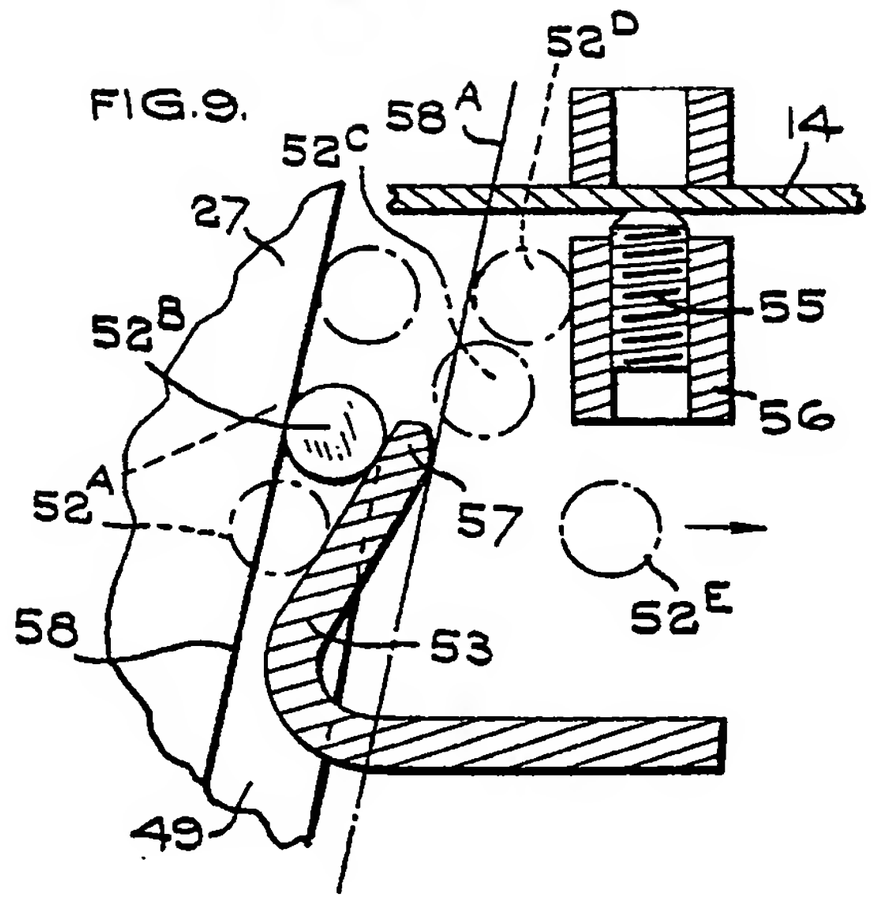
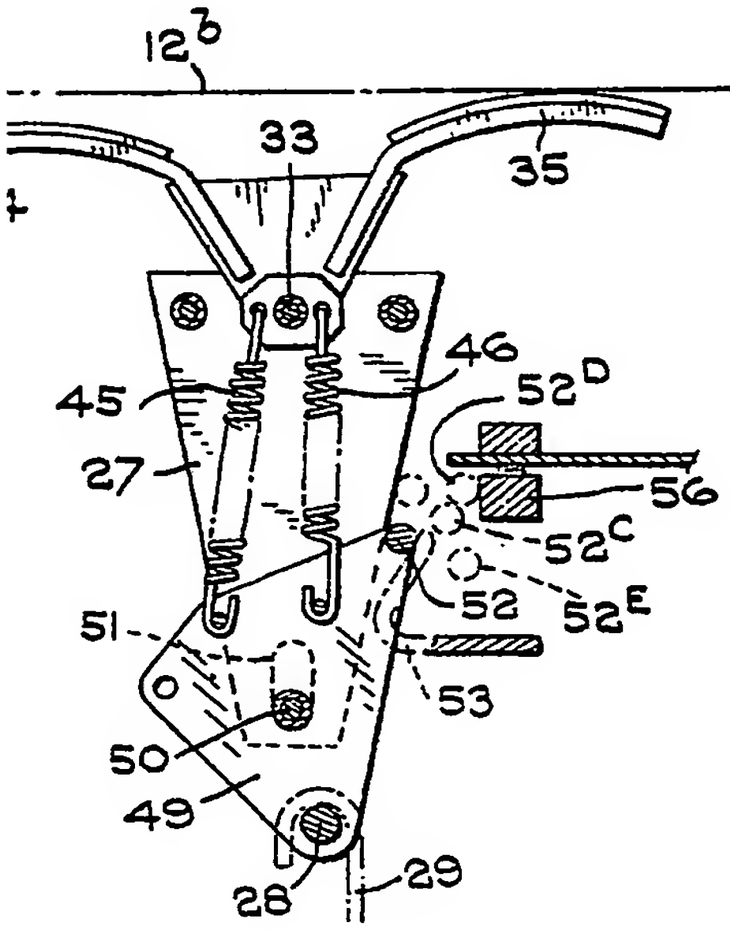


FIG.9.





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3 SHEETS

FIG. 6.

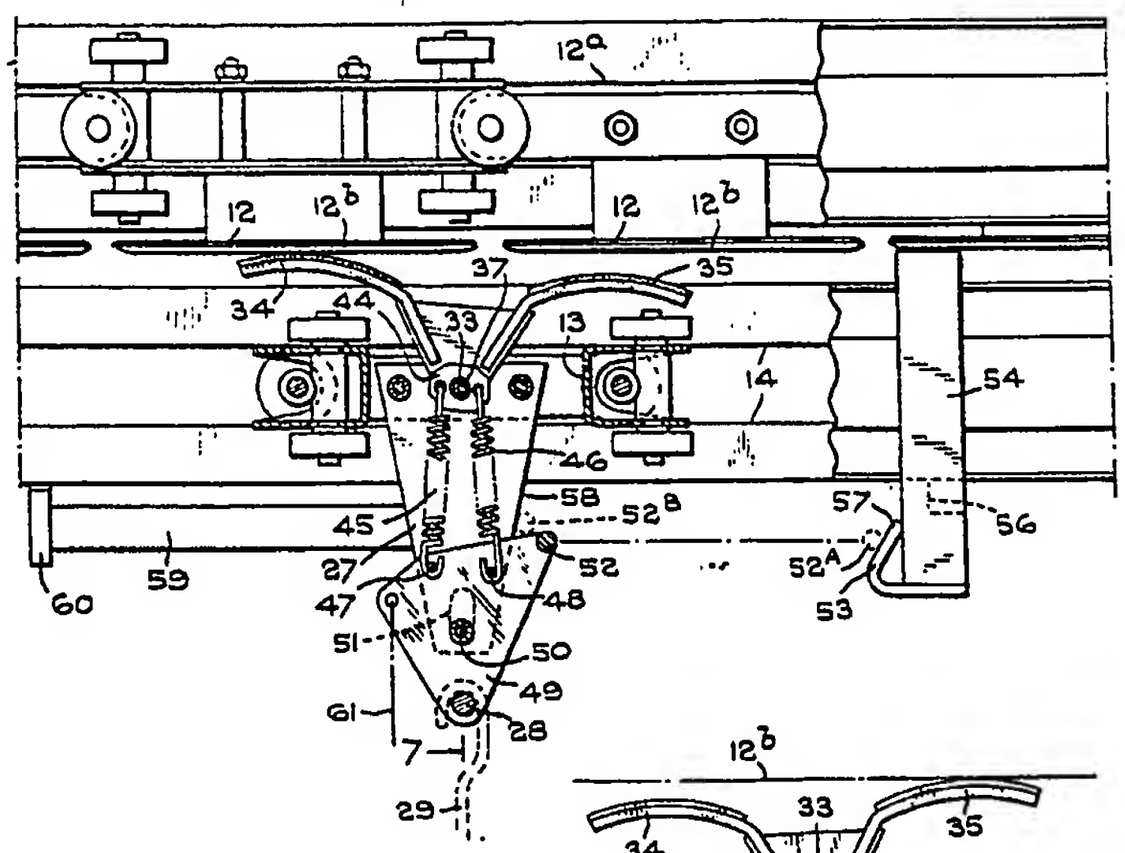

FIG. 8.

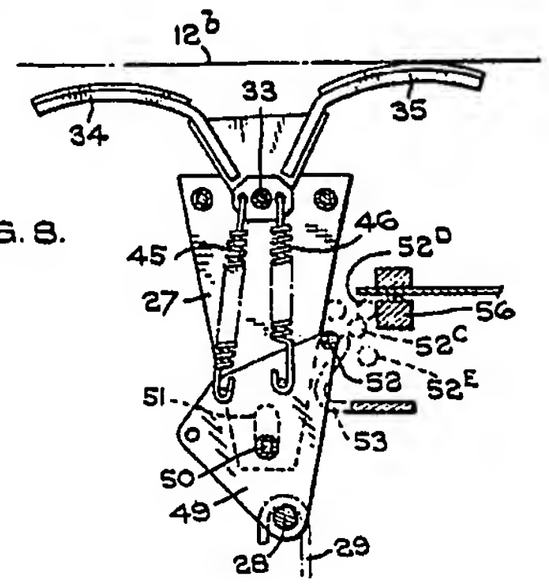

FIG. 7.

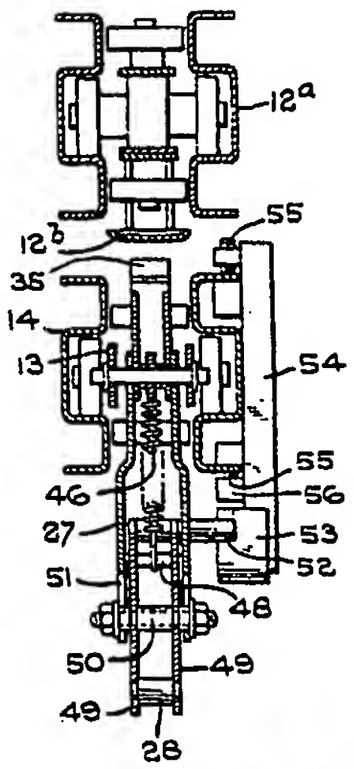

FIG. 9.